Reexamining the Benefits of Forest Bioenergy

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Commonly Assumed Benefits

- Biomass combustion is either “carbon neutral” or reduces GHG emissions
- Forest bioenergy reduces air pollutant emissions from open burning of “waste” and “residual” materials as well as wildfire
- Bioenergy encourages thinning of “overstocked” forests, reducing risk of “catastrophic” fire

Commonly Overlooked Costs

- Increased GHG emissions over significant time scales ("carbon debt")
- Downsides of thinning for wildfire control
  - Reduced forest carbon stocks
  - Forgone ecological benefits of fire
- Serious "sustainability" questions
- Air quality and public health impacts
- Water use and wastewater disposal

Greenhouse Gas Emissions

- Measured at the stack, biomass combustion produces substantially more CO_2 per MWh than coal or gas

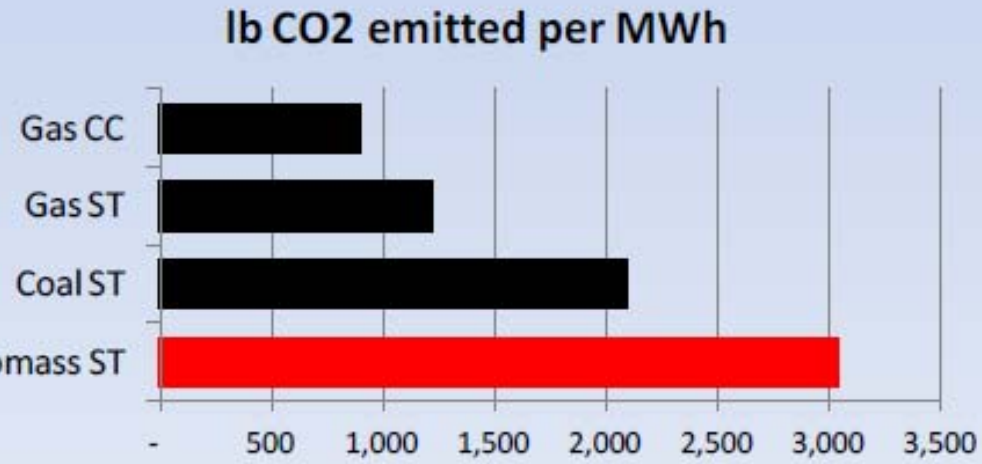
Biomass power facilities emit substantially more CO2 per MWh than coal or gas facilities

	Fuel CO2 per heat content (lb/mmbtu)	Facility efficiency	Fuel mmbtu required to generate 1 MWh	Lb CO2/MWh
Gas combined cycle	117.1	0.45	7.54	**883**
Gas steam turbine	117.1	0.33	10.40	**1,218**
Coal steam turbine	205.6	0.34	10.15	**2,086**
Biomass steam turbine	213	0.24	14.22	**3,029**

A biomass plant emits

~150% the CO2 of a coal plant
~250% the CO2 of a gas plant
~ 340% the CO2 of a combined cycle plant

Fuel CO2 per heat content data are from EIA. Efficiency for fossil fuel facilities calculated using EIA heat rate data (http://www.eia.gov/cneaf/electricity/epa/epat5p4.html); biomass efficiency value is common value for utility-scale facilities.



Greenhouse Gas Emissions

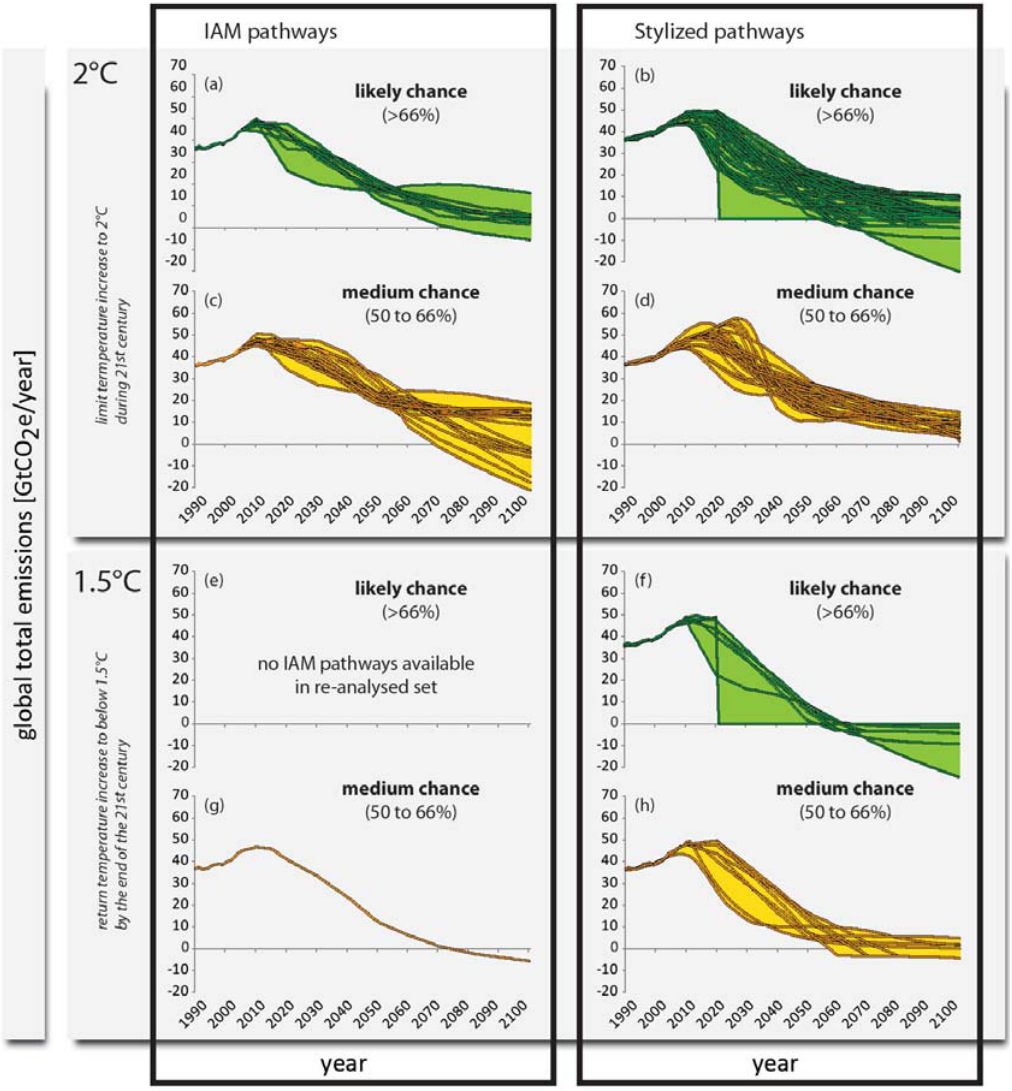
- Gasification is comparable to combustion in terms of stack CO_2e emissions
- Cabin Creek (Placer County):
  - 2 MW gasification plant
  - 26,526 $MTCO_2e$/yr (combustion only)
  - 17,520 MWh/yr
  = 3,338 lbs CO_2e/MWh

Source: Ascent Environmental, Cabin Creek Biomass Facility Project Draft Environmental Impact Report, App. D (July 27, 2012).

Greenhouse Gas Emissions

- Biomass combustion is not by definition “carbon neutral” or “climate neutral”
- Have to compare biomass combustion with what would have happened to materials otherwise: (e.g., burning whole trees: not just lost storage, but also forgone sequestration)
- *Time during which biomass combustion increases CO2 concentrations (“carbon debt” period) can last decades to centuries, depending on source of feedstock*

Timing Matters: Pathways to 2 Degrees



Source: UN Environment Programme, The Emissions Gap Report (2010).

Greenhouse Gas Emissions

"That's all fine in Massachusetts… but in California we're just burning 'waste' from timber harvest and 'residues' from hazardous fuels reduction."

These materials also incur a "carbon debt."

- Slow decomposition emissions v. instantaneous combustion emissions
- Thinned trees from fuels reduction projects are still whole, living trees for C accounting purposes

Forests, Fire, and Carbon

- Campbell et al. 2011: found "little credible evidence" fuels reduction projects increase forest C stocks
  - thinning removes far more C from forest than would be emitted even in high-severity fire
  - forests with low-frequency, high-severity fire regimes had greater C storage
- Hudiburg et al. 2011: found intensive fuels reduction treatments (with harvested materials used for bioenergy) would increase net C emissions over 20-year period across wide range of CA/OR forests
  - 19 ecosystems, 80 different forest types

Sources: John L. Campbell, et al., *Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions?* Front. Ecol. Env't (2011), doi:10.1890/110057; Tara Hudiburg, et al., *Regional carbon dioxide implications of forest bioenergy production*, Nature Climate Change (2011), doi: 10.1038/NCLIMATE1264.

Forests and Fire

- High-severity fire return intervals are much longer now than they were pre-settlement
- Forests long deprived of fire don’t always burn hotter
- High-severity fire has important ecological benefits
- Treatments immediately adjacent to structures are most effective in protecting homes and communities

Sustainability

"We have such strong forestry regulations in California that we don't really need to worry about sustainability."

Sustainability

- CA Forest Practice Rules are far from perfect
  - e.g., cumulative effects analysis
- "Sustained yield" does not necessarily mean "sustainable"
- Rules don't address many practices associated with increased biomass harvest
  - e.g., effect on soils of removing more "waste"
- Recognizing importance of fire requires different thinking about what should count as "fuel"

Air Quality/Public Health

- Air quality tradeoffs: replacing higher (but dispersed and intermittent) emissions with lower (but concentrated and constant) emissions
- Biomass fuel storage hazards

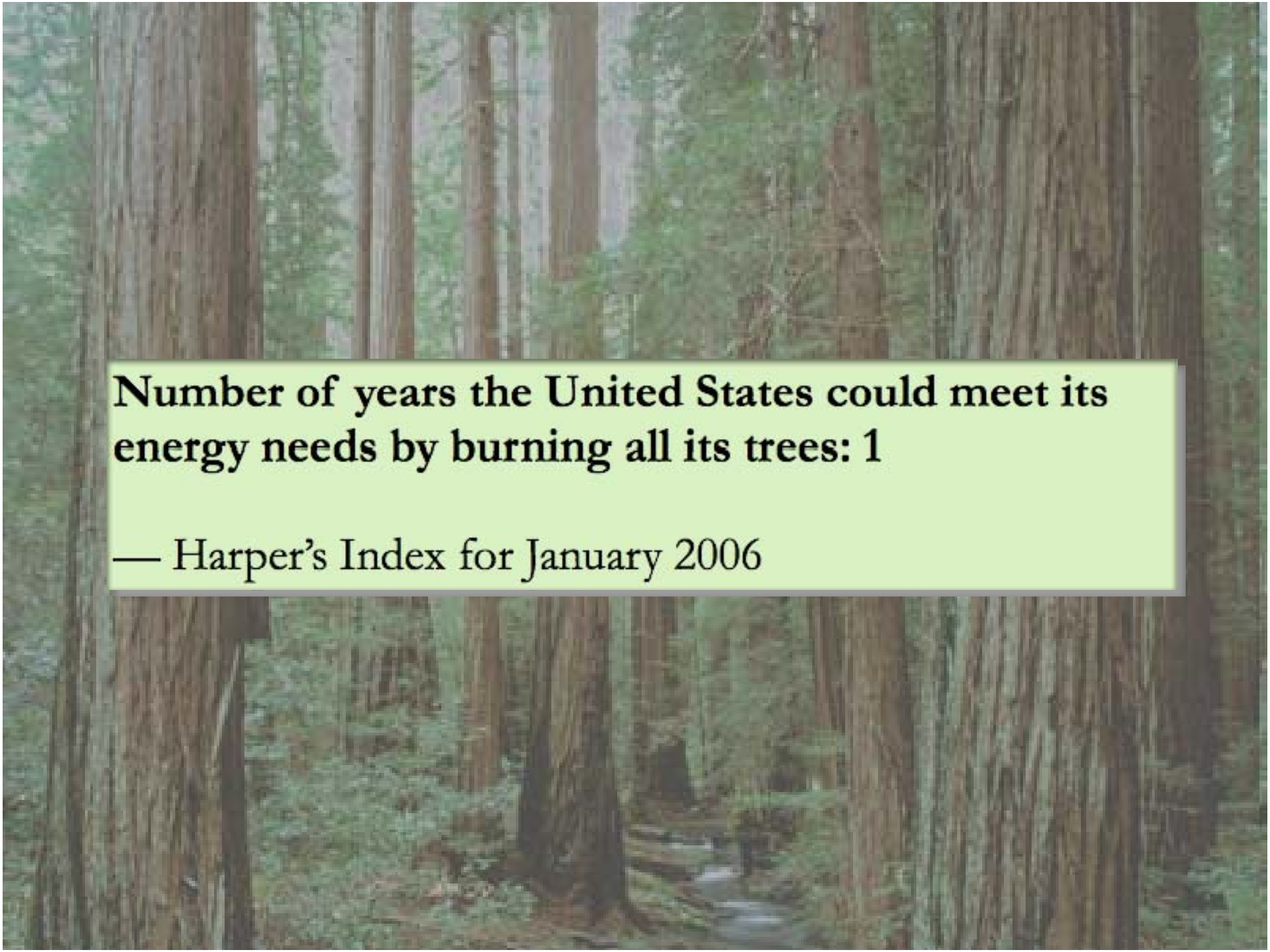
Water Use/Wastewater Disposal

- Cabin Creek (Placer County):
  - 2 MW gasification plant
  - 14,400 gpd water use
  - 14,400 gpd discharge to sewer

Source: Ascent Environmental, Cabin Creek Biomass Facility Project Final Environmental Impact Report, 3-6 to 3-7 (Dec. 4, 2012).

Policy Recommendations

- SB 1122 implementation
  "Strategically located":
  - Focus on forest activities most critical for protecting homes and communities
  - Thorough review of site-specific impacts
  "Sustainably managed":
  - Protect forests from effects of intensive biomass harvest
  - Careful analysis of fuel supply, especially cumulative demand from multiple facilities drawing on same areas
- Reexamine purported "benefits" before taking additional steps to expand forest bioenergy


Number of years the United States could meet its energy needs by burning all its trees: 1
— Harper's Index for January 2006